

Environmental analysis of the valley fills sequences of Teesta River

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In the Sikkim and Darjeeling Himalayas, human settlements have developed on terraces and fan lobes preserved along the Teesta River in the region between the Himalayan Frontal Thrust (HFT) and the Main Central Thrust (MCT). Some of these landforms are under intensive agricultural use. The microseismicity in the region indicates that it is tectonically active. The recent hazardous activities in this region are caused by combination of landslide and high stream discharge in monsoon time. These are highly risky for transport and human settlements.

We prepared a detailed geomorphic map of the region using PAN, LISS and LANDSAT data followed by field checks. The landforms present in the area are terrace, stream fan, channel bars, mountain slopes and flood plains. Tributary stream fans are very common all along the Teesta river having the two main depositional units –fanlobes F_1 and F_2 .

The shape of stream fans is semi-conical with a variable radial angle (60° to 180°). The longitudinal distance varies from 80m to 800m and the radial width varies from 90m-900m of these stream fans. Oldest fan lobes are predominant in the upper reaches of the basins and are composed of debris flow deposits of subangular to angular larger clasts. The youngest stages of the fans are commonly present in highly active landslide areas near the Rangpo town and Kalijhora areas near the Main Boundary Thrust. The slopes of the fanlobe surfaces vary from 3 to 15 . The fanlobe F_2 is 7-9m thick and F_1 is 1- 2.5m thick. We observed that the F_2 fanlobe is absent towards the downstream in the vicinity of MBT from Rangeet river confluence with the main Teesta up to Sevoke. The F_2 lobes are commonly present between MCT near Dikchu in north Sikkim to Tarkhola in North Bengal. These two fanlobe are incised.

The presence of debris flow and hyperconcentrated flood flow deposits in the stream fans indicates that these depositional setting belongs to a regime of intense monsoonal and strong tectonic activities. Also, the region has terraces all along the Teesta River within the MCT and MBT. Strath, paired and unpaired terraces are present at different elevations. Three terrace levels – T_3 , T_2 and T_1 – are conspicuous in the region. The T_3 terrace is built up of thick sand and gravel units deposited by hyperconcentrated flood flow, channel flow, and are preserved all along the river channel. The older fans contain sediments, which were deposited from debris, hyperconcentrated and channel flows.

This region is characterized by high precipitation, which leads to high runoff erosion on the terrace surface and older fan surface. The tributary streams generate hazardous high runoff discharge flows along with landslide materials during the intense monsoon, which can form new fan lobes; and incise and wash out older fan surfaces. For instance, on 1st October 2004 a debris flow destroyed the bridges and main retention walls on the Benkhola and eroded away materials from terrace and fan lobes. First order drainages are developed in the high angle scarps; colluvium and slides have developed on these scarps during the higher flood level of stream. The stream tributary fans and terraces are cut at several places for the construction of roads and buildings. These activities have rendered older stream fan lobes and the terrace more unstable. Before planning any developmental activity on the older terrace and stream fan surfaces of this region, their lithology, lithofacies and geomorphology must be critically studied to assess their stability and to adopt suitable engineering measures towards this.